NOTES, ABSTRACTS, AND REVIEWS.

THE FUNDAMENTAL EQUATIONS IN THE HYDROLOGY OF RIVER REGIONS.

By KARL FISCHER.

[Abstracted from translation made by W. W. Reed from *Meteorologische Zeitschrift*, 1921, pp. 331-336.]

The author discusses the fundamental equations in the hydrology of rivers. These equations are necessarily based upon one's conception of the relative quantities of water vapor originating over oceans and land areas, respectively. Since the amount of water vapor carried by ocean winds that pass over continental areas is not susceptible of definite determination and, moreover, since the moisture that falls as rain on land areas may be reevaporated, not only once but several times, the discussion of the relations between these quantities and the run-off from land areas must naturally take on an academic character.

The author starts with the simple proposition,

$$N = A + V \qquad (1)$$

where N is the amount received at the surface of the ground, A is the run-off, and V is the evaporation.

His second step is to consider the quantity of water vapor carried by the air which passes over any watershed. The author distinguishes by M the amount of water vapor coming, in the last analysis, from the sea: over against this is placed the run-off, A, as before, and, E, the amount of water vapor escaping (evaporating) into the air, so that his fundamental equation now becomes

$$M = A + E \qquad (2)$$

The question as to the relative amounts of vapor transported from the ocean to the land, and vice versa, is discussed. The author comments upon the view of Brückner on this and other closely related subjects, and the latter makes a rejoinder. The translation of both Fischer's article and Brückner's rejoinder are filed in the Weather Bureau Library, where they may be consulted by those interested.—*A. J. H.*

THE VARIABILITY OF TEMPERATURE IN SUCCESSIVE MONTHS AND THE PERIODIC OSCILLATIONS OF ANNUAL TEMPERATURE IN GERMANY.

By FRANZ BAUR.

[Abstract of Doctor's Dissertation, translated by W. W. Reed from *Meteorologische Zeitschrift*, April, 1922.]

For this investigation there were taken as a basis temperature observations for the period of 50 years from 1870 to 1919, inclusive, at the following 10 stations in Germany: Königsberg (Prussia), Berlin, Hamburg, Breslau, Leipzig, Munster (Westphalia), Bamberg, Frankfort-on-the-Main, Munich, Karlsruhe (Baden).

From the monthly means of temperature for these 10 stations there was calculated the mean temperature for Germany in each month of the 50 years and the departure from the 60-year mean. For the representation of the temperature contrasts between successive months there was introduced the concept of "month-to-month change in temperature," the difference in the temperature departures of two directly successive months. The mean value of a series of such differences was called "month-to-month variability." In Germany the month-to-month variability amounts on an average to 1.7° C. It shows an annual and a semiannual oscillation. The annual oscillation is a result of the annual march of the "mean" variability of the monthly means of temperature, which is greater in winter than in summer; the semiannual oscillation is caused by the annual march of temperature itself, since the minima of the double wave of month-to-month variability occur where the temperature shows a maximum or a minimum. To the annual march of month-to-month variability there corresponds also the annual march of tendency to maintain the sign of temperature departure. This shows a considerable amount of tendency (not accidentally caused) only from February to March. This tendency to maintain temperature departure from February to March is plainly an accompanying circumstance to the phenomenon that in Germany the character of the winter with reference to temperature extends in most cases to the following March. Especially does this prove true for mild winters. In the years 1870 to 1919, inclusive, in 78 per cent of the cases (in Germany) a too-warm March followed a too-warm winter.

By means of Fourier's analysis investigation was made as to whether the month-to-month variability shows periods of more than a year's duration. There were calculated the amplitudes of 52 different periods, of which the shortest was 1.6 years, while the longest period was 20 years. For the determination whether those periods for which there resulted the greatest amplitudes are actually present, there was employed Schuster's test, as well as a phase test given by Professor Ansell. It resulted that periods of month-to-month variability in temperature of 2, 2.5, 3.4, 4.5, and 5.5 years duration are very probably real.

From the definition of "month-to-month variability" it could be demonstrated by a simple mathematical deduction that it can contain true periods only when the course of the temperature itself contains true periods, and that the temperature periods must be twice as long as the periods of month-to-month variability. As the double annual wave of month-to-month variability is a result of the annual temperature wave, so to the periods of month-to-month variability of 2, 2.5, 3.4, 4.5, and 5.5 years there correspond temperature periods of approximately 4, 5, 7, 9, and 11 years. In order to make a decision as to the reality of the periods the temperature departures were subjected to further analysis. It could be established conclusively that in the temperature course in Germany for the years 1870 to 1919 there are contained actual periods with duration of oscillation nearly 2.5, 4, 7, and 11 years. The analysis of the annual temperature departures gave the greatest amplitudes for an 18-year period and a 36-year period. The observational data is for a period too short to establish with certainty the reality of periods so long, still the close agreement of the 18-year period with the Chaldean period of lunar eclipses and with the period of the movement of the moon's nodes and the agreement of the 36-year period with the well known Brückner period make the reality of these periods quite probable.

In the period from 1870 to 1919 the maximum of the 11-year temperature period falls two-thirds of a year after the sun spot maximum.[1]

By ascertaining the amplitudes and the phases of the well-known temperature periods for shorter lengths of

[1] It is generally recognized that terrestrial temperatures are at a minimum at times of sun-spot maximum.—EDITOR.

time and by extrapolation beyond the last observation year (for the time being) there resulted the probability of a prediction of the thermal character of the following observation period of from 2 to 3 years, with the restriction that there is limitation to the distinction of the following chief types: Very warm—warm—normal—cool—cold. In order to test the utility of such predictions, the necessary calculations were carried out for each year of the period from 1900 to 1918, and in each of the 19 cases predictions were made for one, two, and three years. Although the analysis could not be carried out strictly since, on account of the short period of observation it was not possible to take an exact account of the long periods, still there were among the 57 predictions only 6 (16 per cent) that were found contrary to the temperature characteristics actually met with. A comparison of the calculated temperature departures with the observed departures by means of the "correlation method" showed that the probability of an "accidental" agreement of the previously calculated temperature departures with the actual departures is less than 1/10,000,000. The good agreement between experience and prediction permits us to view as correctly made the assumption that the agreement is entirely general and not only in the limits of the observational data at hand. Therewith the difficult problem of the prediction of the thermal character of the coming years is brought nearer relative to the principle of solution. It depends on the exceedingly important demonstration that in the temperature course in Germany there are contained actual periods of long duration.

The extension of the same investigation to other meteorological elements, as well as to the subdivisions of the year, is naturally very obvious. The execution of these investigations and their application I reserve for a further work already undertaken.

FORECASTING THE WEATHER, PARTICULARLY STORMS, FROM PILOT-BALLOON OBSERVATIONS.

By J. Lacoste.

[Abstracted from *Comptes Rendus*, November 21, 1921, pp. 997-999.]

During more than two years in the meteorological service of the third army, having practised soundings by pilot-balloons every four hours day and night, the author tried to find a relation between the forms of graphs of the horizontal projection of the course of the balloon, the data of synoptical weather charts, and the behavior of the barometer. From this comparison, he has deduced some conclusions which may be helpful in forecasting:

Different types of soundings have been classified as follows:

(1) Soundings at constant direction—those in which the lower and upper winds maintain sensibly the same direction.

(2) Soundings at an abrupt angle—the upper winds suddenly taking directions, generally from the west, contrary to those of the lower winds. Two layers of air, one gliding over the other without friction.

(3) Turning sounding—those in which the wind changes progressively its direction with altitude. For example, the lower winds being east or southeast, the upper winds becoming south-southwest and west with altitude. Two layers of air mutually penetrating.

(4) Soundings in which the winds of the layer 0 m. to 2,000 m. change direction rapidly with time and are from many different directions for neighboring stations.

(5) Soundings indicating winds weak and variable in direction up to great heights.

From the point of view of forecasting, the author makes the following remarks:

(1) The soundings of the first class are characteristic of cyclonic areas or the edges of anticyclones. The direction of the winds permit finding the direction of the center of the depression; it is usually found from the direction of the winds about 1,000 m. The changing of the general direction of the winds with time indicates the displacement of the center and permits determining the direction of this displacement.

(2) The soundings at an abrupt angle announce a distant depression. If successive soundings show the angle to be at higher and higher altitudes the depression is not to be feared. If the angle falls progressively, the depression is dangerous, the upper winds grow in force, the barometer falls. The upper winds appear to come from the low center.

(3) Soundings turning from east or southeast to south, southwest, and west with altitude are precursors of storms. Not only do they indicate a low area invading France from the southwest (Spain, Gulf of Gascony), but if the lower winds attain 4 or 5 m. one should look for the storm in 24 hours at the place of the sounding or in the neighborhood. In winter there will be snow.

(4) Soundings of the fourth class characterize the secondary depressions, barometric pockets. They show that in similar circumstances, only the winds of the 0-2,000 m. layer experience rapid variations with time. Above them one finds the winds that direct the principal depression. Similar soundings are also the precursors of storms in summer and snow in winter.

(5) Soundings of the fifth class are made on high anticyclonic plateaus or toward the center of vast cyclonic areas.

—*G. F. H.*